Latest Technology in Irrigation Management in Nursery Production©

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Irrigation efficiencies in nursery production are providing a reduction in water use, delivering cost savings and reducing environmental impacts, as well as realising substantial productivity increases for production nurseries. The challenge is to encourage growers to invest in new technology with confidence by providing the necessary support framework that delivers validated information, technical resources, and targeted research to assist growers embrace change and achieve a positive return on their investment. Over the past 6 years the NGIQ on-farm support to production nurseries across Queensland has achieved water savings and productivity gains exceeding $50 million dollars in value to industry.

INTRODUCTION

The Nursery & Garden Industry Queensland (NGIQ) in partnership with the Queensland Department of Environment and Resource Management (DERM) is encouraging production nurseries to adopt more efficient on-farm water use practices through participation in the South East Queensland Irrigation Futures program (SEQ-IF) and Rural Water Use Initiative (RWUE). The SEQ-IF Nursery Production Project has operated continuously since May 2006 in the South East corner of Queensland along with the RWUE Nursery Production Project in regional Queensland, encouraging improved irrigation efficiencies and a reduction in on-farm water use, through the industry developed Nursery Production Farm Management System (FMS). The nursery production FMS encourages growers to adopt industry best management practice (BMP) in production (NIASA), environmental management (EcoHort), and on-farm biosecurity (BioSecure HACCP).

The 800 production nurseries located within the project areas are extremely diverse and highly intensive, with their production intended for various target markets including ornamentals, forestry, fruit and vegetable, landscape, revegetation, etc. The value of nursery production to Queensland exceeds $800 million (DPI&F Prospects December 2010) per year and with an estimated 70-80% of production emanating from south east Queensland with the remaining volume shared between northern and central Queensland. It is estimated that the cropping value of $800 million is derived from more than 2000 ha of land. The projects have gathered and evaluated relevant production statistics showing average returns of $400,000 and average applications of 22.5 ML of water per ha. (Nursery production across Queensland is estimated at producing $17,700 of crop value per ML of water applied.)

IRRIGATION EFFICIENCIES

Since the commencement of the SEQ-IF/RWUE Nursery Production Projects in May 2006, drought conditions and water security have been the major drivers for water use efficiency (WUE) improvements in the nursery production sector. More recently, opportunities for productivity efficiencies and cost savings (e.g., energy) are motivating grower engagement in the SEQ-IF/RWUE projects and continuing investment in system upgrades. On-farm WUE investment has included irrigation system improvements to part or all crop production areas, irrigation delivery system upgrades, water quality enhancement, as well as changes to irrigation management practices. Historically growers have experienced difficulty in accessing industry specific information, resources, and technology to support on-farm investments in WUE, however the SEQ-IF/RWUE projects have provided the necessary technical, research and extension support over the past 6 years complementing the industry levy funded research program.

The nursery industry has, over time, developed a range of quality resources including an irrigation best practice workshop program, WaterWork, a comprehensive irrigation guide, *Nursery Industry Water Management Best Practice Guidelines*, and the comprehensive text, *Managing Water in Plant Nurseries: A guide to irrigation, drainage and water recycling in containerised plant nurseries*. These tools and resources have been extensively utilised by the SEQ-IF/RWUE projects for presentation to growers and irrigation supply companies through workshops, field days and one on one extension.

Research projects, such as the 2007 Horticulture Australia Limited (HAL)/Industry Levy funded irrigation project, have provided extensive information on the value of improving irrigation systems and delivery technologies. The above project focused on retrofitting the irrigation systems of two production nurseries in South East Queensland with more efficient irrigation technologies and upgrading the irrigation system design. The outcomes of the irrigation retrofit were analysed and the resulting information provides valuable benchmark data for use within the SEQ-IF/RWUE projects.

SUMMARY OF THE PROJECT OUTCOMES

Prior to the retrofit the production nursery applied 70% town water (potable) and 30% dam water provided on-farm. The changed irrigation system allowed a substantial reduction in town water supply and a greater use of the available dam water. For changes in water use results refer Table 1.

Table 1. Annual water use results for a production nursery in the project.

Annual water usage Area of retrofit 0.8 ha	Old system (Kilolitres water/year)	New system (Kilolitres water/year)	Change (Kilolitres water/year)
Town water	15,221	1,314	-13,907
Dam water	6,534	10,996	4,462
Total water usage	21,755	12,310	-9,445

The retrofit has provided annual water savings of 9.4 ML, a reduction of 43% from the previous system. The new system uses 87% dam water and only 13% town water. The significant reduction in town water has real savings in the costs of water (Table 2).

Table 2. Financial return on investment.

Assessment criteria	Production nursery
Retrofit investment	$77,594
Net present value (NPV) of investment (10 years)	$171,577
Benefit/cost ratio	3.2
Change in annual business profit	$24,070

The benefits of the system changes are:

- The efficiencies gained by the new irrigation system have allowed greater use of dam water and much less use of town water supply.
- The new irrigation system provides an even distribution of water resulting in a decrease in the number of plant throw outs and savings to variable costs and labour inputs.
- The new irrigation system requires less water pressure, therefore, saving wear on pumps and pipes and significant savings in electricity costs.
- The completed drainage system channels excess water back to the dam for reuse.
- The efficiencies gained by the new irrigation system have resulted in a much dryer plant production area reducing container cleaning and weed growth.
- The dryer plant area results in reduced plant disease and a decrease in fungicide required and application costs.
- The drier plant area creates a more efficient working area including paths and roads.

- The efficiencies gained by the new irrigation system have resulted in a decline in fertiliser leaching, therefore improving plant nutrition resulting in improved plant growth, plant vigour and more even plant growth.

TECHNOLOGICAL DEVELOPMENT

A range of decision support tools and calculators have also been developed under the SEQ-IF/RWUE projects to provide assistance to growers conducting system upgrades. iSPACE is an irrigation sprinkler database for production nurseries that can be used to analyse a system's needs and identify suitable sprinklers for various spacings, pressures, and flow requirements. The Dripper and SprayStake Assessment Tool allows growers to make dripper and spraystake selection decisions based on container size and growing media ingredients. iPLANT is under development to provide data encouraging the grouping of plants with similar water requirements (high, medium , and low) together into irrigation zones.

Table 3. Identified irrigation efficiencies, benefits, and savings.

Irrigation efficiency benefits	Savings
Water use efficiency savings	20-60% water saving
	Improved water security
More even distribution of water	Improved crop uniformity
	Improved crop turnover/m²
	Reduced picking and consolidation costs
	Lower throw-outs/less wastage
	Decrease in ancillary and labour costs
Lower system operating pressure	Less system breakages (pipe and fittings)
	Reduced maintenance (pump and filtration)
	Lower energy consumption
Irrigation application rates to match growing media absorption rate	Less leaching from containers
	Reduced environmental risk
Reduced pest and disease incidence	Healthier crops
	Lower labour costs through less pesticide use
Less pesticide applications	Lower human and environmental risks
	Less risk of contaminated runoff
Shorter irrigation run times	Drier production areas
	Improved work timetable

A recent case study of a business operating under the Nursery Production FMS and completing an irrigation system upgrade identified 25% savings in water and energy use, a $4,500/annum saving in pesticide applications, and identified significant improvements in productivity from the upgraded production area (Table 3). The on-farm improvements identified a 12.5% productivity increase in reducing the crop growing cycle delivering a saving to the grower of $43,000/annum, and a 5% germination improvement providing a $17,500 productivity improvement. The reduced crop growing cycle and reduction in throw-outs provided a financial return to the grower of approximately $60,500 per annum.

The SEQ-IF/RWUE projects have recognised that all significant water savings and productivity increases gained from system upgrades can only be achieved and maintained with subsequent modifications to irrigation management practices. Sound irrigation scheduling decisions are required to achieve and sustain water saving and productivity increases in existing systems as well as new and upgraded irrigation systems. Grower irrigation application decisions are historically based on visual observation and past experience, and require new tools and resources to understand and manage new scheduling decisions.

The SEQ-IF/RWUE Nursery Production Projects are funding research into managing

irrigation scheduling to provide growers with new tools and resources to make informed irrigation management decisions. A portable weight-based scheduling tool (PWBST) has been developed for short term installation on-farm to data log the changing weight of containers due to evapotranspiration, rainfall and irrigation within a production area (Fig. 1). This provides a graphical history of current and changed practices that can be used to evaluate schedules, along with educating and assisting growers making future irrigation management decisions.

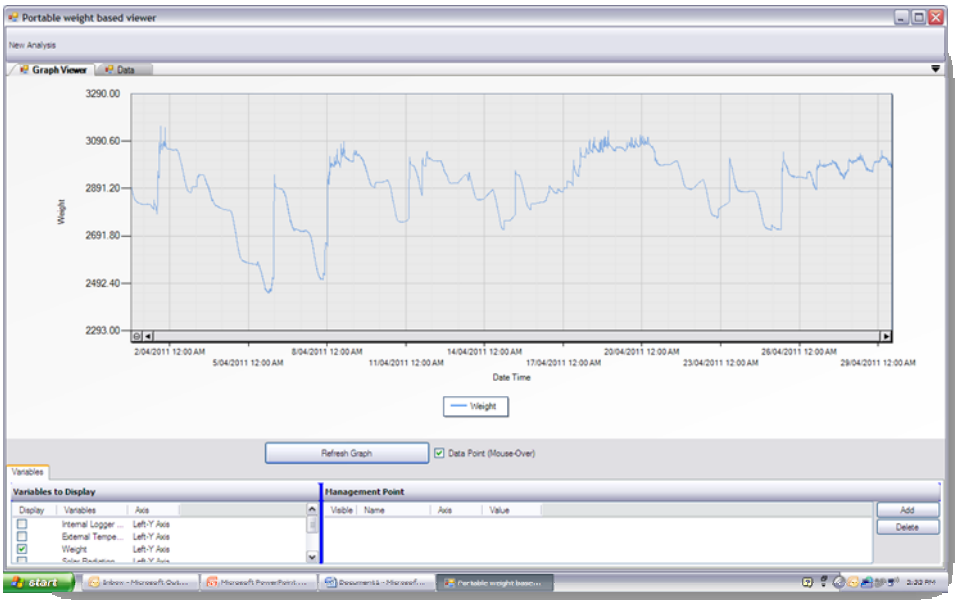

Fig. 1. Graphical display (PWBST) of crop weight change over time.

Funding has also been allocated for the research and development of a weight based irrigation controller to manage nursery container irrigation, based on the changing weight of the growing container, rather than the current time based system (Fig. 2). Initial system trials have proved successful with 50% water use savings against standard industry practice of time based controllers. This project is moving to the next development stage with a trial underway at DAFF Queensland Redlands Research Station.

Fig. 2. Components of weight based irrigation controller.

The research is simulating a small production nursery in the R & D shade-house at the DAFF Queensland - Redlands Research Station (RRS) to determine the efficacy and efficiency of a weight-base scheduling device to automate irrigation of container crops. The project will develop an irrigation control unit (PC based software) that will automate the monitoring of container weight and determine irrigation according to pre-set parameters such as time of day, irrigation windows, and environmental conditions.

The controller is also expected to identify any permanent increase in total weight that can be attributed to foliage and root growth over time. A self-adjusting program that can alter irrigation to account for weight increases will be applied and tested. The results of the self-adjusting irrigation program will be compared to the industry standards of timed and evapotranspiration (ET) irrigation scheduling.

As a by-product the trial has the potential to provide specific plant water use data during production and identify high growth periods. This data can assist in developing a customised irrigation scheduling practice for plants with different water use requirements and also assist in determining a crop factor for the variety of plants trialled. The information could be fed into the NGIQ database on plant water use to assist in production modelling and pre-determine the volume of water needed to produce a crop.

Literature Cited

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